

ABSTRACT

The U.S. Environmental Protection Agency has announced plans to regulate mercury to the atmosphere from coal-fired power plants. However, there is still over whether the limits should be placed on a nationwide basis or a plant specific nationwide mercury emission limit would allow a Cap and Trade program similar to other pollutants. A Cap and Trade program would be more economically efficient specific emissions limits. However, before a Cap and Trade program is selected as acceptable approach, it must be demonstrated that local deposition of mercury from fired power plants does not impose an excessive health risk to the region.

Although mercury is a concern, quantitative assessment of the reduction in risk that be achieved through reduction in coal plant emissions of mercury has not been nor have the risks associated with local deposition been evaluated. To address the health risks associated with local deposition of mercury, probabilistic risk performed for two power plants, Bruce Mansfield in western Pennsylvania and eastern Texas. These plants were selected because they have high emissions rate reported in the 1999 emissions survey conducted by EPA (Monticello had the mercury emissions in the country). Local hourly meteorological data was obtained for sites and deposition modeling was performed for a region 50 Km around the site. deposition modeling indicated that dry deposition downwind from the plant could lead increases of less than 30% in deposition over background. Model projections wet deposition within the first 5 km around the plant could be substantially above background. Risk assessments were performed for two population groups (general subsistence fishers) and the modeled deposition patterns. The risk assessments incremental risks to the population groups associated with local deposition and found to be small for the general population ($< 10^{-5}$ risk of observed neurological effects) could be two orders of magnitude higher for subsistence fisher populations.

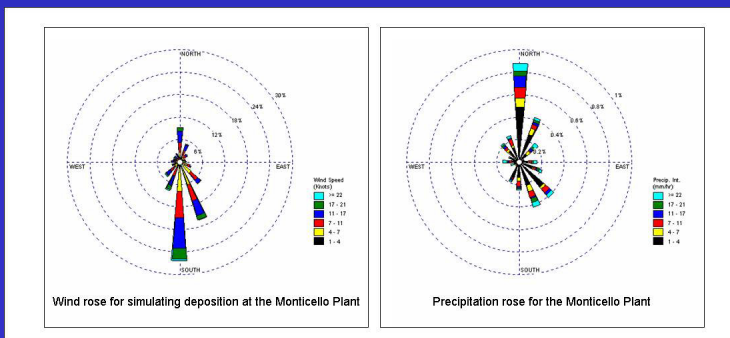
HEALTH IMPACTS OF LOCAL Hg DEPOSITION

Approach

- Model local deposition for the Monticello, TX plant (highest Hg emissions in the US in 1999) and Bruce Mansfield PA plant using Hg speciation data on emissions, meteorological data from nearby areas, the software package ISCVIEW and deposition parameters used in EPA Report to Congress
- Compare deposition to background which is approximately 20 $\mu\text{g}/\text{m}^2/\text{yr}$
- Probabilistically Assess Health Impacts of Increased Local Deposition

Meteorological Data

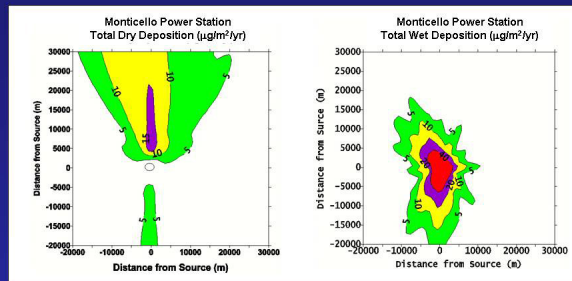
- Hourly wind and precipitation data from 1990 taken from nearby weather stations was used to model local deposition. Examples below were used for simulating deposition near the Monticello Plant. Windrose data for Bruce Mansfield indicated the prevailing winds were from the southwest.



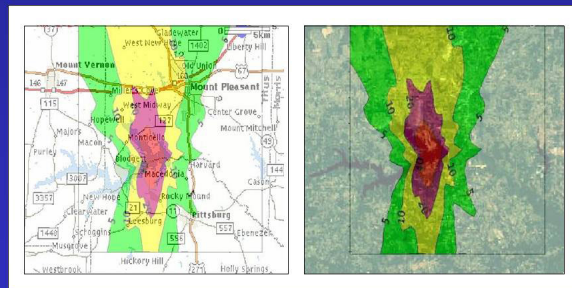
DEPOSITION MODELING RESULTS

Predicted dry and wet deposition around the Monticello Power

Wet deposition characterized by higher deposition rates near the plant. Dry deposition peaks further from the plant in the direction of the prevailing winds. Wet deposition occurs at higher rates, while dry deposition occurs over larger areas. Predicted deposition rates near the plant are more than twice the expected background. Total mass deposited is similar. High deposition rates are a function of the large fraction of reactive gaseous mercury and the high emissions rates.

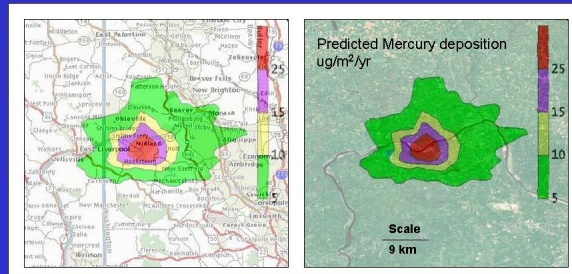


Total predicted Hg deposition ($\mu\text{g}/\text{m}^2/\text{yr}$) with surface maps and photograph.



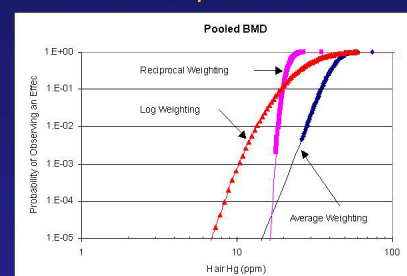
Predicted total deposition around the Bruce Mansfield Power Plant.

Wet deposition characterized by higher deposition rates near the plant. Dry deposition peaks further from the plant in the direction of the prevailing winds but is less than 5 $\mu\text{g}/\text{m}^2/\text{yr}$. Lower deposition rates than near the Monticello plant reflect the lower percentage of reactive gaseous mercury and lower emissions rates.

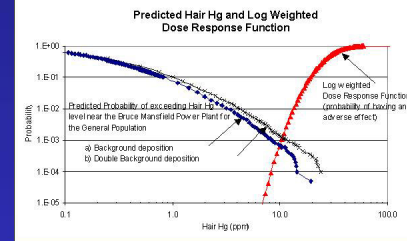


EXPOSURE MODELING RESULTS

Benchmark Dose Response Curves



Predicted Hair Hg for the base case (no increased exposure) and doubling of deposition within the first 5 Km of the plant. Risk is the product of the fraction of population at each Hair Hg level multiplied by the Dose Response Function



RESULTS OF LOCAL DEPOSITION MODELING AND RISK ASSESSMENT

Deposition Results

- Approximately 2% of total Hg emissions deposit within 50 Km of the plant. Remaining 98% enters global budget.
- Reactive gaseous mercury is the dominant form of deposited Hg. Approximately 5 – 7% of RGM emitted is deposited within 15 km of the plant.
- Wet deposition within a few km of a plant can lead to deposition several times background.
- Total deposition is approximately 50% wet deposition and 50% dry deposition.
- Uncertainties in deposition modeling parameters need to be addressed.

Increase in Risks due to Local Deposition

- Risk defined as a 5% chance of receiving an adverse effect.
- Population Risks to the general population increase from 1E-5 to 1.7E-5
- Population Risks to subsistence fisher population increases by a factor of 3.5 from 6.3E-3 to 2.2E-2.
- Risk dominated by the upper 5-10% of the distribution (i.e. high fish consumers within the distribution).